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RESEARCH ON MAINTAINING BODY POSTURE STABILITY OF FUTURE STATUTORY OFFICERS

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Annotation. The article reviews indices of maintaining body posture stability of the students, future statutory officers. The research was performed when the students under research were standing on a computerized balancing platform „Libra“. The research was participated by 62 students (28 men and 34 women) already studying a discipline of martial self-defence. There were performed 3 tests: when standing on the platform with eyes open, with eyes closed and aiming at a target – simulating a shooting. Such tests were selected purposefully: statutory officers – police officers and border guards – have to use physical abuse or even a service weapon when performing their direct functions. In order to perform such actions correctly and resultatively, one of the conditions necessary is adequate coordination peculiarities, ability to maintain body posture stability in specific situations. During the research, the indices were recorded that characterize peculiarities of maintaining students‘ body posture stability – an area of deflection from the model line, deflection time, stability index. There were recorded particular tendencies of maintaining body posture stability, however, substantial difference of indices between male and female results we not identified.

Keywords: students; future statutory officers; men and women; balance stability; standing with eyes open, eyes closed, aiming at a target.

INTRODUCTION

Statutory officers - police officers and border guards - must be physically prepared, able to perform actions of martial arts properly[1]. In order to avoid injuries and perform duties properly, good coordination abilities, maintaining a stable body position are necessary. Body posture stability is a human's ability to maintain a proper body position when performing particular actions or when a human is influenced by external forces[2]. Development of this ability is especially important for the statutory officers, who are forced to use certain actions of

[1] Lietuvos Respublikos Policijos veiklos įstatymo Nr. VIII-2048 pakeitimo įstatymas. 2015 m. birželio 25 d. Nr. XII-1856. (26, 27 str.). [interactive]. https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/605bccb020b011e58a4198cd62929b7a. [accessed 2020-05-02]
[2] Raczek J., Mynarski W., Ljach W. *Developing and diagnosing of co-ordination motor abilities*. AWF, Katowice 2002, 11-25.

physical abuse when maintaining public order, detaining offenders[3]. In order to maintain a stable position, it is necessary to be able to assess external impact and to coordinate a tension of human's muscles and tendons adequately to the forces[4]. A mechanism of movement execution is closely related to sophisticated physical and chemical processes taking place in human's organism. It is stated that an important role in this process is played by a musculoskeletal system tensed up in a balanced way on the one hand, and biochemical reaction taking place at a molecular level[5]. The path of human motoric development is long enough - from physically active games in childhood to a maturity period[6]. The quality of physical readiness and process of movements' learning is also of sufficient importance for human motoric formation because the ability to maintain a stable body position remains for the rest of the time[7],[8]. In the pre-pubertal period, balance indices of girls are better than those of boys, possibly influenced by earlier maturation of proprioceptive, visual and vestibular systems. In the process of maintaining body stability these systems play an important role[9]. In this regard, physical activity is an important circumstance, since more physically active people are characterized by a higher level of movement control skills[10]. Coordination abilities associated with coordination of movement precision, perception of time and speed of a moving object are changing with time - are improving with an increasing age[11]. The proprioceptive system is also influenced by such factors as muscle tension tone, skin tactility, strength of pressure in the feet and joints. It should be noted that weakening of sensory function negatively affects posture

[3] Lietuvos Respublikos Policijos veiklos įstatymo Nr. VIII-2048 pakeitimo įstatymas. *op.cit*, p. 2.
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stability[12]. Even in elementary form, physical activity positively influences the process of development of people with motoric development disorders[13]. In the process of training of new movements and consolidation of those already mastered, the ability to maintain a stable body position plays an important role[14]. Actions of martial arts and even more so a precise shooting are particularly useful in the research of visually controlled movement, because it is strictly limited in space and time, creates unambiguous and separated results (hitting the target), and requires sophisticated psychomotoric skills dependent on high mental and physical coordination. Coordination abilities significantly affect the quality of performance of actions in duel sports. It was determined that strength and endurance training exercises are limiting a training of movement motoric, while improvement of action technique, competitive method and sparring are optimizing. The higher the level of technical and tactical readiness, the more accurately and faster the ability to perform various movements, actions. A positive correlation was established between reaction time and athletic achievements in duel sports[15]. The ability to maintain a stable body position has an impact significant enough on accurateness during shooting. Due to body fluctuations, the shots are more scattered from the centre of the target in vertical plane, and due to the movement of the arm with the weapon – in horizontal plane. According to the research authors, body fluctuation and pistol movement have almost no interdependence[16]. It was determined that maintaining a stable body position in relation to the horizontal plane is more difficult than in relation to the sagittal one[17]. This is due to the factors such as muscle contraction and reaction rate, morphology of human body parts and other

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https://www.researchgate.net/publication/235986776_Factors_Affecting_Accuracy_in_Pistol_Shooting· [accessed 2020-05-05].
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features [18],[19]. Multiple, repetitive, specific exercises of duration up to 30 seconds with a total duration of up to 8-10 minutes positively affect the ability to maintain a stable body position on an unstable basis[20].

The vision factor significantly affects posture control[21]. Special training, in order to maintain a potentially more stable body position when aiming at the target after a certain amount of exercise, gives positive results[22]. It also should be noted that for the athletes of high athletic skill, systematic, specific training makes the impact of the visual function on maintaining a body stability less significant[23].

When developing and improving the abilities of body stability, it is important to know that improper physical exertion, exercise, can bring undesirable results at least temporarily. Physical activity, to which energy is provided in anaerobic way, does not significantly affect the maintenance of body stability under static conditions[24]. Running at a moderate intensity disrupts the stability of body posture more than walking[25]. Muscle fatigue[26], deeper and more rapid breathing under the influence of exercise[27], elimination of visual function[28] also aggravate the process of maintaining body balance. It should be clarified that increased breathing has a greater impact on posture stability in regard to the horizontal plane than to the sagittal one[29]. Residual phenomena of running affect body stability more negatively than cycling[30],[31].

[18] Lech G., *op.cit*., p.158.
[19] Masani K., Popovic M.R., Nakazawa K., Kouzaki M., Nozaki D. Importance of body sway velocity information in controlling ankle extensor activities during quiet stance. *Journal of Neurophysiology*. 2003, 90, 3774–3782.
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[24] *Ibid.*
[25] Derave W., Tombeux N., Cottyn J., Pannier J.L., De Clercq D., Treadmill exercise negatively affects visual contribution to static postural stability. *International Journal of Sports Medicine.* 2002; 23(1), 44–49.
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[30] Derave W, *supra* note 25.
[31] Lepers R, Bigard AX, Diard JP, Gouteyron JF, Guezennec CY. Posture control after prolonged exercise. *European Journal of Applied Physiology*. 1997; 76(1): 55 – 61.

Body stability is influenced by strong muscles that are correcting vertical position by the movements in the hip or ankle joint[32]. Most corrective body stability movements are carried out in these joints, and a little less – in the knee and hip joints[33]. Balance-keeping abilities can be trained. A human can maintain stable body position as long as he keeps the vertical perpendicular to the base of his body line. The increase in strength and endurance of the back muscles is strongly associated with posture stability and the lower the centre of person's overall body mass, the more stable the posture[34]. Human's head position also plays a significant role in maintaining body balance[35].

The purpose of this paper – to identify the ability of students, future officers, to maintain a stable body position under different conditions.

Methodology.

The article analyses body stability indices of 62 students (28 men and 34 women) with an average age of 20 years. The researched students have already studied the discipline of Martial self-defence. The balancing platform "Libra" was used to study the indices of dynamic body balance. It is interconnected with the computer whose program provided the intended indices:

- general area of deflection to the right (GAr) and to the left (GAl) side of the pre-set difficulty line;
- external area, the area of deflection to the right (EAr) and left (EAl) zone outside the limit of the specified line of difficulty level of the movement path;
- external time, the time when the subject remains on the outer right (ETr) and left (ETk) side beyond the line of difficulty level of the specified movement path;
- recovery time – the longest time when the subject remained outside the limit of the difficulty level of the specified movement path (right – RTr and left - RTl);
- the total values of general deflection (GAd+k), total external area (EAr+l) and total tilt (ETr+l) and total recovery time (RTr+l) and the sum of the times of these constituents (GT);
- body stability index (SI).

[32] Winter D.A., *supra* note 26.
[33] Åstrand PO., Rodahl K., Dahl H.A. et al. *Textbook of work physiology: physiological bases of exercise*. Champaign (Ill.): Human Kinetics. 2003.
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Based on the average of all variables, the software calculates the stability index (SI), where 100 denotes the worst and 0 represents the best stability of the body. External area is expressed in relative units, and time – in seconds[36]. The subjects had to stand on the platform in such a way that the feet were parallel to each other, the legs were straight, the hands were lowered along the body but would not touch it. The research was conducted by using a feedback - the computer was positioned at a distance of 1 m at the eye level of the subject. When conducing the test with eyes closed, the deflection from the established model line was informed by an audible signal and partially by the administrator of the research. The test characteristics were explained to the subjects. Prior to each stage of the research (test), the subject was given a 30 s preliminary measurement. After a relaxation of 30 seconds, the subject performed a test that took 60 s. Three valid tests were carried out. The first test was performed by standing on the platform with eyes open (O), the second - with eyes closed (C) and the third - when aiming at the target, i.e. simulating pistol shooting (Sh). The research protocol was designed so that the subject fully recovered from the test. The scientific literature provides various data on the indices of the stability of the human body with respect to the horizontal and sagittal planes. There are claims that better are the stability indices in relation to the sagittal plane[37],[38] and others - that to the horizontal one[39], but in static conditions. Considering the findings of the researchers[40], [41] as well as the specifics of movements during self-defence actions or shooting, a priority was given to the research of stability changes in the horizontal plane (deflection to the right or to the left side).

Methods of mathematical statistics were used to process recorded indices, and analytical methods were used to discuss the results obtained.

RESEARCH RESULTS

No statistically significant difference was recorder between the majority of the subjects in the researched group when standing on the platform with their eyes open (Table 1). Only a few indices differed. Average result for the group of general deflection area to the right (GAr)

[36] Tchórzewski D., *supra* note 17.
[37] Tchórzewski D., *supra* note 17.
[38] Zemková E., *supra* note 23.
[39] Masani K., *supra* note 19.
[40] Zemková E., *supra* note 23.
[41] Tchórzewski D., Bujas P., Jankowicz-Szymańska A.., Body posture stability in ski boots under conditions of unstable supporting surface. *Journal of Human Kinetics*. 2013; 38: 33–44.

was significantly higher than that of general deflection to the left (GAl) (p<0,005). Total values of general deflection (to the right and to the left) area (GAr+l) are higher (p<0,001) than total values of external area (EAr+l). Also, total values of external time (ETl+r) are higher (p<0,001) than values of recovery time (RTr+l) to the model path. In the male (M) group, there were statistically significant differences only between the same types of total indices - GAr+l were higher than EAr+l (p<0.001), and total indices - ETl+r were higher than RTr+l (P<0.001) (Table 1). By analogy to men, a reliably significant difference between the indices of the same group was in the female group as well.

There were more statistically significant differences in results among women. GAr indices are higher (p<0,005) than GAl and ETr are higher (p<0,05) than ETl. There was no statistically significant difference in body stability between the male and female groups when standing on the platform with their eyes open.

During the second test, when standing on the platform with eyes closed (Table 2), in both groups (M+W) and separately in the male (M) and female (W) groups, there were determined analogous statistically significant differences between the total indices GAr+l and EAr+l (p<0,001) and total indices ETl+r and RTr+l (p<0,001). There was no statistically significant difference between other indices in the male group. In the group of all subjects (M+W) and the group of women (W), there was a statistically significant difference in the number of indices that characterize greater body balancing ability.

Table 1. Stability indices for men and women standing on the platform with their eyes open (O).

	GAr	GAl	EAr	EAl	ETr	ETl	RTr	RTl	SI	GAr+l	EAr+l	ETr+l	RTr+l	GT
M+W	No.1	No.2	No.3	No.4	No.5	No.6	No.7	No.8	No.9	No.10	No.11	No.12	No.13	No.14
ẋ	115,6	88,9	21,1	16,5	7,5	6,0	1,5	1,3	12,2	204,5	37,6	13,6	2,8	16,3
Sx	6,3	6,6	3,4	2,9	0,7	0,7	0,1	0,1	0,8	9,7	5,5	1,2	0,2	1,3
p	No.1-2 0,005		No.3-4 0,302		No.5-6 0,122		No.7-8 0,148			No.10-11 0,001		No.12-13 0,001		
M (ẋ)	110,9	101,3	19,2	21,2	7,3	7,1	1,4	1,4	12,7	212,3	40,4	14,3	2,9	17,2
Sx	7,2	10,0	3,3	4,8	0,9	1,1	0,1	0,2	1,2	14,2	7,3	1,9	0,3	2,1
p	No.1-2 0,4		No.3-4 0,7		No.5-6 0,9		No.7-8 0,9			No.10-11 0,001		No.12-13 0,001		
W (ẋ)	119,6	78,2	22,8	12,4	7,8	5,1	1,6	1,1	11,8	197,9	35,1	12,9	2,7	15,6
Sx	10,1	8,5	5,7	3,4	1,0	0,8	0,2	0,2	1,1	13,5	8,1	1,5	0,3	1,7
p	No.1-2 0,005		No.3-4 0,123		No.5-6 0,05		No.7-8 0,069			No.10-11 0,001		No.12-13 0,001		
M-W*p	0,50	0,08	0,60	0,12	0,72	0,17	0,51	0,28	0,58	0,465	0,635	0,551	0,750	0,56

M+W* (total of all the subjects); M* (indices of men); W* (indices of women); M-W*p (t values - between indices of men and women)

There were differences in total indices of all subjects (M+W), GAr and GAl (p>0.005), EAr and EAl (p<0.01), ETr and ETl (p<0.01), RTr and RTl (p<0.005) and accordingly analogous (p<0.01); (p<0.05); (p<0.05); (p<0.01) indices of the female (W) group. There was no statistically significant difference between women and men.

Table 2. Stability indices for men and women standing on the platform with their eyes closed (C)

	GAr	GAl	EAr	EAl	ETr	ETl	RTr	RTl	SI	GAr+l	EAr+l	ETr+l	RTr+l	GT
M+W	No.1	No.2	No.3	No.4	No.5	No.6	No.7	No.8	No.9	No.10	No.11	No.12	No.13	No.14
ẋ	245,4	202	112	90,0	20,6	17,4	3,3	2,6	32,6	447,5	201,9	38,0	5,9	43,9
Sx	9,6	9,3	5,9	5,5	0,9	0,8	0,2	0,1	0,9	10,6	8,0	0,9	0,3	1,1
p	No.1-2 0,005		No.3-4 0,01		No.5-6 0,01		No.7-8 0,005			No.10-11 0,001		No.12-13 0,001		
M (ẋ)	238,5	201,8	107	90,7	20,2	17,3	3,1	2,6	32,0	440,3	197,4	37,4	5,7	43,1
Sx	12,1	15,0	7,2	8,8	1,2	1,3	0,2	0,2	1,4	16,9	12,0	1,6	0,3	1,8
p	No.1-2 0,06		No.3-4 0,17		No.5-6 0,11		No.7-8 0,21			No.10-11 0,001		No.12-13 0,001		
W (ẋ)	251,1	202	116	89,5	20,9	17,5	3,6	2,5	33,1	453,5	205,7	38,4	6,1	44,5
Sx	14,4	11,9	9,0	6,9	1,2	1,0	0,3	0,2	1,2	13,6	11,0	1,1	0,4	1,4
p	No.1-2 0,01		No.3-4 0,05		No.5-6 0,05		No.7-8 0,01			No.10-11 0,001		No.12-13 0,001		
M-W*p	0,52	0,98	0,42	0,91	0,67	0,88	0,20	0,73	0,55	0,542	0,613	0,591	0,460	0,54

M+W* (total of all the subjects); M* (indices of men); W* (indices of women); M-W*p (t values - between indices of men and women).

During the third test (Sh), when standing on the platform and aiming at the target, i.e. simulating a pistol shooting, statistically significant differences were found in almost all indices of the total (M+W) and female (W) group (No. 1 and 2; No 3 and 4, etc. - Table 3).

Table 3. Stability indices of men and women standing on the platform and aiming the weapon at the target (shooting- Sh)

	GAr	GAl	EAr	EAl	ETr	ETl	RTr	RTl	SI	GAr+l	EAr+l	ETr+l	RTr+l	GT
M+W	No.1	No.2	No.3	No.4	No.5	No.6	No.7	No.8	No.9	No.10	No.11	No.12	No.13	No.14
ẋ	155,9	88,3	33,3	18,1	12,6	6,3	2,7	1,4	15,5	244,2	51,4	19,0	4,1	23,0
Sx	10,0	8,0	3,7	3,2	1,2	0,8	0,3	0,2	0,9	9,9	5,4	1,4	0,3	1,7
p	No.1-2 0,001		No.3-4 0,002		No.5-6 0,001		No.7-8 0,001			No.10-11 0,001		No.12-13 0,001		
M (ẋ)	141,3	105,3	32,2	24,4	10,7	8,1	2,3	1,4	15,7	246,6	56,6	18,8	3,8	22,6
Sx	12,2	13,1	5,5	5,4	1,3	1,4	0,4	0,2	1,3	15,5	9,4	1,9	0,4	2,2
p	No.1-2 0,05		No.3-4 0,32		No.5-6 0,16		No.7-8 0,03			No.10-11 0,001		No.12-13 0,001		
W (ẋ)	167,9	74,3	34,3	12,9	14,2	4,9	3,0	1,3	15,3	242,2	47,2	19,1	4,3	23,4
Sx	15,1	9,4	5,0	3,5	2,0	0,9	0,5	0,3	1,2	12,9	6,2	2,0	0,5	2,5
p	No.1-2 0,001		No.3-4 0,001		No.5-6 0,001		No.7-8 0,01			No.10-11 0,001		No.12-13 0,001		
M-W*p	0,188	0,05	0,77	0,06	0,17	0,05	0,3	0,71	0,82	0,83	0,39	0,92	0,453	0,81

M+W* (total of all the subjects); M* (indices of men); W* (indices of women); M-W*p (t values - between indices of men and women).

In the male (M) group, there was observed a lower number of indices characterizing statistically significant differences in body balance retention ability compared to women in this test.

Only GAr were higher that GAl ($p<0,05$), GAr+l were higher than EAr+l ($p<0,001$), RTr was higher than RTl ($p<0,03$), and duration of ETl+r was higher than RTr+l ($p<0,001$). When compared to the results of the female study, this test showed higher GAl ($p<0,05$) and ETl ($p<0,05$) in men.

In both groups of men (M) and women (W), there was a statistically significant difference in all indices of balancing ability when standing on a platform with eyes open and eyes closed (O-C) (Table 4). Having compared the results from the tests performed when standing on the platform with eyes open and simulating a shooting (O-Sh), a statistically significant difference was found between almost the same group of indices in women (W) and men (M) (Table 4). Unlike men, there was no statistically significant difference between EAr indices recorded in these tests (O-Sh) in the female group. In the male (M) group, there were 4 statistically significant differences between 14 indices measured during the first and the third tests (O-Sh) (GAr $p<0,04$; EAr $p<0,05$; ETr $p<0,03$ and RTr. $p<0,03$). There were statistically significant differences ($p<0,001$) in all indices of the tests performed in the groups (M+W), (W) and (M) when standing on the platform with eyes closed (C) and simulating a shooting (Sh), with the exception of RTr (Table 4).

Table 4. Difference between male and female stability indices (t values of the index) when standing on the platform and "shooting", with eyes open and eyes closed

	GAr	GAl	EAr	EAl	ETr	ETl	RTr	RTl	SI	GAr+l	EAr+l	ETr+l	RTr+l	GT
(M+W)	No.1	No.2	No.3	No.4	No.5	No.6	No.7	No.8	No.9	No.10	No.11	No.12	No.13	No.14
O-C	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
O-Sh	0.001	0.954	0.02	0.707	0.001	0.776	0.001	0.655	0.01	0.005	0.075	0.01	0.01	0.01
C-Sh	0.001	0.001	0.001	0.001	0.001	0.001	0.086	0.001	0.001	0.001	0.001	0.001	0.001	0.001
(M) O-C	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
O-Sh	0.04	0.811	0.05	0.565	0.03	0.57	0.03	0.952	0.100	0.107	0.176	0.098	0.062	0.076
C-Sh	0.001	0.001	0.001	0.001	0.001	0.001	0.117	0.001	0.001	0.001	0.001	0.001	0.001	0.001
(W) O-C	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
O-Sh	0.010	0.753	0.133	0.925	0.005	0.839	0.006	0.617	0.03	0.02	0.244	0.016	0.013	0.012
C-Sh	0.001	0.001	0.001	0.001	0.01	0.001	0.31	0.001	0.001	0.001	0.001	0.001	0.01	0.001

M + W(total of all subjects); M* (indices of men); W* (indices of women); O-Sh (t - values - between test indices: eyes open and "shooting"); O-C (t-values - between test indices: eyes open and eyes closes); C-Sh (t-values- between test indices: eyes closed and "shooting").

DISCUSSION OF RESEARCH RESULTS

Researched future police officers have been studying the discipline of Martial self-defence. They had to maintain a certain level of physical readiness[42] during the study of this subject, however there was a possibility that their body stability maintaining indices might be lower than those of other study participants who actively trained in certain sports[43] ,[44]. While performing a visual comparison, the indices of our students and the students of the University of Physical education in Cracow [45], some tendencies of differences can be seen. In our group of the subjects the indices of GAr+l (204,5±77,3(SD)); EAr+l (37,6±33,3(SD)); ETl+r (13,6±9,4(SD)); SI (12,2±6,4(SD)) when standing on the platform with eyes open, visually are higher. It is likely that the relatively worse average results compared to the subjects of the University of physical education in Cracow were due to large differences in the body stability indices of our subjects. It was determined that morphological indices of the body and the level of physical readiness significantly affect the stability of the balance. The higher the centre of mass and the weaker the muscles of the torso, the more difficult it is to maintain a stable body position[46,47.]. The students who participated our study stood on the platform without shoes. The students, future police officers, are equipped with special uniform including high-heeled shoes stabilizing the ankle joint. It is likely that the stability indices in the sagittal plane would be different if the students were standing on the platform wearing the ankle stabilizing footwear that is partially similar to that of skiers[48].

Visual function significantly affects posture control[49],[50],[51]. Data from our research confirmed this statement. The subjects deflected more from the model line and spent more time in the "off-limits" zone when standing on the platform with their eyes closed than with their eyes open. This situation is recorded in both, female and male group. In both tests, (O) and (C),

[42] Lietuvos Respublikos vidaus reikalų ministro įsakymas 2019 m. sausio 15 d. Nr. 1V-55 „Dėl Lietuvos Respublikos vidaus tarnybos statuto įgyvendinimo“ [interactive]. https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/8ae81cc2190111e9bd28d9a28a9e9ad9. [accessed 2020-05-05].
[43] Derave W, *supra* note 25.
[44] Zemková E., *supra* note 23.
[45] Tchórzewski D., *supra* note 17.
[46] Ángyán L., *supra* note 34.
[47] Saavedra S., Woollacott M., van Donkelaar P. Effects of postural support on eye hand interactions across development. *Experimental Brain Research.* 2007; 180(3): p. 557–567.
[48] Tchórzewski D., *supra* note 41.
[49] Keshner E.A., *supra* note 21.
[50] Mergner T, *supra* note 28.
[51] Zemková E., *supra* note 23.

there was no statistically significant difference between female and male indices. Average indices GAr recorded in the female group were relatively higher for each of the 3 tests (O, C, Sh) than for men. During the test (O), the average GAl indices recorded in women were lower than in the male group almost by 20 units. During the third test (Sh), there were recorded indices GAl and ETl, that were statistically significantly lower ($p<0.05$) in women compared to men. We cannot explain the reasons for this situation in detail. There is an evidence[52] that at a young age, women have better balance stability than men. In our research, apart from the above-mentioned difference between GAl and ETl indices of the (Sh) test, no evidence of a statistically significant difference between the rates of the female and male groups was found.

It is important for the officers to maintain a potentially more stable position of the body and weapon. This circumstance is of a particular importance when it comes to the use of a service weapon, as a stable body-gun interface determines a better result of standing shooting [53]. Attention should be paid to the fact that in almost all tests of our research there were recorded higher GAr than GAl and higher ETr than ETl. In the female group, a statistically significant difference in these indices was recorded during all three tests (O, C, Sh). In the male group it was recorded only between GAr and GAl and RTr and RTl during "shooting" (Sh). When testing experienced and novice shooters, there were detected more significant lateral oscillations [54]. While performing their functions, the officers have to detain offenders by using the actions of physical abuse, special means etc. All that requires for considerable physical efforts. While performing physical work that is intensive enough, an acidosis due lactate that is accumulated in the organism may lead to a significant increase in breathing, worsening of posture stability[55]. If officers would have to chase the offender at a run for a longer period of time, a fatigue is likely to impair their vision function, and ability to maintain a needed stable body position[56]. Maintaining a stable body position can also be aggravated by incorrect posture[57]. Due to tension of the neck muscles, a fatigue can provoke a prolonged feeling of

[52] Dorneles P. P., Pranke1 G. I., Mota C. B. Comparison of postural balance between female and male adolescents. *Fisioterapia Pesquisa*. 2013: 20 (3); 210-214.
[53] Sattlecker G., Buchecker M., Müller E., Lindinger S.J. Postural Balance and Rifle Stability during Standing Shooting on an Indoor Gun Range without Physical Stress in Different Groups of Biathletes. *International Journal of Sport Science & Coaching*. 2014, 9(1):171-184.
[54] Niinimaa V., ., *supra* note 22.
[55] Zemková E., ., *supra* note 23.
[56] Derave W., ., *supra* note 25.
[57] Fox C.R, ., *supra* note 35.

instability[58]. If an officer in such a state should defend himself against aggressive offenders, should use actions of martial self-defence or a service weapon, most likely the result would not be the most optimal. In order to improve the ability to maintain the stability of the body, constant physical exercise, possibly more varied, in regard to locomotion, physical exercises are required. It is necessary to pay attention to the nature of the exercise as well. According to data of researches, basketball representatives demonstrate a worse static balance than gymnastics representatives, and dynamic balance is worse than that of football representatives[59]. Future officer should include exercises that require quickness, sudden force into the physical skills training process. Such exercises, up to the individual threshold, would improve the speed of reaction and at the same time the ability to maintain the body in a stable state[60].

Considering the results obtained, in order to improve the physical character of coordination, it is advisable to use specific exercises and their complexes in the training process of future statutory officers to help develop the ability to maintain a stable position of the body in a variety of situations, especially non-standard ones.

CONCLUSIONS

Given unstable ground when standing with eyes open, eyes closed and aiming at the target, i.e. simulating a shooting, the stability abilities of women and men are similar, except when the weapon is aimed at the target. During the pistol "shooting ", the recorded indices of the deflection area to the outer zone (to the left side) in the female group are statistically reliably lower than in the male group. A similarly shorter left-side stay outside the specified difficulty level has been recorded.

The indicators of stability indices for the male and female groups are relatively similar. When standing with eyes closed, in women, the indices of deflection to the right of the total area, the area of deflection, the time of stay in it and the time of recovery from it are significantly higher than of deflection to the left. In simulated shooting, the total area of deflections to the right in both men and women is significantly larger than to the left.

[58] Schieppati M., Nardone A., Schmid M. Neck muscle fatigue affects postural control in man. *Neuroscience*. 2003; 121 (2): 277-285.
[59] Bressel E., C Yonker J.C, Kras J., Edward M Heath E.M. Comparison of Static and Dynamic Balance in Female Collegiate Soccer, Basketball, and Gymnastics Athletes. *Journal of Athletic*. 2007; 42(1): 42–46.
[60] Kosinski R.J. *A Literature Review on Reaction Time*. [interactive]. http://www.fon.hum.uva.nl/rob/Courses/InformationInSpeech/CDROM/Literature/LOTwinterschool2006/biae.clemson.edu/bpc/bp/Lab/110/reaction.htm [accessed 2020-05-11].

For both men and women, it is more difficult to maintain a stable body position with eyes closed than in other circumstances studied. There is seen a tendency for men to maintain a more stable body position during "shooting", in other words, to "lose" less stability than women (according to the difference in the indices in O and Sh of the researches).

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